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HARD ANTI-ICING COMPOSITION

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HARD ANTI-ICING COMPOSITION

[Trednyi antigololednyi sostar]

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The invention relates to the chemical industry and concerns anti-icing compositions.

The problem of combating snow and ice formations has long existed, but has still not bee solved.

Winter sliding is being combated along three lines:

- improvement of the grip of wheels on icy roads;
- removal of snow and ice formations from the road cover;
- prevention of the formation of slippery conditions.

In correspondence with these directions various methods have been developed for combating wintertime slipping:

- friction;
- heat;
- mechanical;
- chemical;
- biochemical.

This invention concerns a chemical anti-icing composition. Of the domestically produced agents there is, for example, the anti-icing composition "KAMA," which contains 40-75% calcium chloride, 24-50% sodium chloride, 1-5% water of crystallization and inert impurities. The composition is produced in granular form (Russian Patent 2044118, September 20, 1985).

However, this composition has a number of drawbacks, namely it is harmful to green plants and soil, and also causes corrosion to the undercarriages of vehicles.

The closest analog in nature and technical result is a solid anti-icing composition containing urea, magnesium nitrate, the surface-active substance OP-10 or OP-7, and water (Russian Patent 2123022, Cl. C 09 K 3/18, published December 10, 1998).

Its shortcomings include the low retention time on the road and the lack of multifunctionality.

The task of this invention is to broaden the range of solid anti-icing compositions that have improved effectiveness and a multifunctional range of use both for preventive treatment of roads and for operations with thick and thin layers of solid ice and during snowfall.

This task is solved by the fact that the sold anti-icing composition contains urea, magnesium nitrate, the surface-active agent OP-10 or OP-7 and water, where the magnesium nitrate is used in the form of a complex compound with ammonium nitrate and is a waste product obtained in the production of nitrogen fertilizers, and the composition additionally contains carboxymethylcellulose, or finely divided cellulose, or polyvinyl alcohol, in the following ratio of components, wt%:

Urea 53-60.

Surface-active agent OP-10 or OP-7 0.1-1.0.

Complex compound of magnesium nitrate with ammonium nitrate – waste product obtained in the production fertilizers 37-42.5.

Carboxymethylcellulose, or finely divided cellulose, or polyvinyl alcohol 0.3-3.0.

Water-remainder.

The solid anti-icing composition can additionally contain calcium carbonate or calcium nitrate.

Tests of the ability of the new composition to melt ice at various temperatures were carried out. Monolithic ice and snow with a density of 0.3 kg/m^3 were used for the tests. The results are given in Tables 1 and 2.

The formulations of the compositions are given in Examples 1-3.

The technical result of this invention is an ecological composition, high retention on the road, absence of a tendency to cake during storage, non-aggressiveness with respect to metal, and lower consumption of the composition.

Example 2 [sic; 1].

Urea 56 wt%

Complex compound of magnesium nitrate with ammonium nitrate – waste product obtained in the production of nitrogen fertilizers 40 wt%.

Surface-active OP-10 0.5 wt%.

Carboxymethylcellulose 2 wt%.

Water – remainder.

Example 2.

Urea 53 wt%.

Surface-active agent OP-7 0.1 wt%.

Complex compound of magnesium nitrate with ammonium nitrate - waste production obtained in the production of nitrogen fertilizers 37 wt%.

Finely divided cellulose 0.3 wt%.

Calcium carbonates 3 wt%.

Water – remainder.

Example 3

Urea 54 wt%.

Surface-active agent OP-10 0.3 wt%.

Complex compound of magnesium nitrate with ammonium nitrate – waste production obtained in the production of nitrogen fertilizers – 39 wt%.

Polyvinyl alcohol 2 wt%.

Calcium nitrate 2 wt%

Water – remainder.

This is supported by the fact that the magnesium nitrate in the composition is contained in a complex compound with ammonium nitrate. The compound itself is a waste product. In addition, only the selected ratio of components in the composition will assure the necessary

result. For example, if a greater quantity of CMC is added to the product, it will thicken and treatment of a surface with the composition will be impeded. If a smaller amount is used the tendency to roll off the surface will be higher.

The claimed composition can be produced by any known and traditional method. The composition is nontoxic, nonflammable, nonexplosive, noncorrosive with respect to AMTs aluminum, DL-16 duraluminum, and type 400 concrete. Its friability is 100%. The eutectic point of a 40% solution is 22.4°C.

Finely ground ice was used to produce a snow analog. The amount of melted ice (water) was determined by volume. It can be seen from the table that the disclosed composition is 100% active substance. Next, tests were carried out of the rate of melting of monolithic ice. Here the weight ratio of ice to anti-icing reagent was 10:1, and the rate of melting was determined at all of the indicated temperatures, by measuring the height of the unmelted ice after 15 minutes. The results are given in Table 3.

It was noted in conducting these tests that the granules of the composition penetrate into the thickness of the ice, breaking down its structure. This property was studied in more detail. For this, ice was frozen in copper cylinders and the depth of penetration of the reagent over 30 minutes was determined a various temperature. The results are shown in Table 4.

Then an asphalt concrete covering was used as a substrate for ice. The height of the ice frozen on the asphalt was 10 mm. At a temperature of -10°C the ice was treated with the granules. After 15 minutes the granules had reached the asphalt base, completely destroying the bond between the ice and the road cover. The granules dissolve very slowly in this case, which produces a prolonged effect.

It is evident from these data the advantages of the use of the granulated composition, the granules of which, by rapidly penetrating through the layer of ice to the road fabric, destroy the bond between the fabric and the ice. As soon as this bond is ruptured, the ice coating breaks up and is easily removed. Another undoubted advantage of the composition is complete absence of the tendency to cake during storage. This was confirmed by experiments in which this reagent was held for 30 days without packaging under conditions of 100% relative humidity, at temperatures from +20 to -20°C.

An important drawback of anti-icing solutions is their tendency to roll of off the roadway rapidly. This shortcoming is eliminated by the addition of carboxymethylcellulose (CMC) to the composition, in the disclosed amounts. The addition of a larger quantity of CMC than disclosed leads to excess thickening, which severely impedes the treatment of the surface with such a composition. The addition of CMC leads to the formation of a liquid gel, which will stay on the road fabric much longer, will run off from uneven surfaces less, thereby substantially reducing

the consumption of the agent. There are no changes of the eutectic properties and other characteristics are not degraded.

Tests of corrosion activity were carried out. Samples of uncorroded autobody steel were used for the tests of the anti-icing reagents. The results were evaluated from the loss of weight of the steel after 20 days. It was noted that the composition is noncorrosive, and under its effect on the metal there is a significant slowing of corrosion over time. The composition can be recommended for preventive treatment of road, it can be used during snowfall and to combat thin layers of monolithic ice at temperatures to -20°C. This composition can be used when there are thick sheets of ice and packed snow at temperatures to -20°C.

Claims

1. A solid anti-icing composition containing urea, magnesium nitrate, the surface-active agent OP-10 or OP-7, and water, which is distinguished by the fact that it contains magnesium nitrate in the form of a complex compound with ammonium nitrate which is a waste product obtained in the production of nitrogen fertilizers, and it additionally contains carboxymethylcellulose or finely divided cellulose or polyvinyl alcohol in the following ratio of components, wt%:

Urea 53-60

Surface-active agent OP-7 or OP-10 0.1-1.0

Complex compound of magnesium nitrate with ammonium nitrate – waste product obtained in the production of nitrogen fertilizers 37-42.5

Carboxymethylcellulose or finely divided cellulose or polyvinyl alcohol 0.3-3.0

Water – remainder.

2. A solid anti-icing composition as in Claim 1, which is distinguished by the fact that it additionally contains calcium carbonate or calcium nitrate.

Table 1. Weight of monolithic ice (kg) melted when using 1 kg of reagent

Температура(С)	15 мин.	30 мин.	1 час
-18	0,4	0,4	0,8
-12	0,9	1,5	1,7
-7	1,8	2,6	4,2
-3	2,2	3,4	4,3

Key: 1 Temperature

2 min.

3 hour

Table 2. Weight of anti-icing reagent needed to melt 100 g of snow, time not determined

Температура град.С	г
-1	1,5
-3	5,1
-6	10,4
-9	14,2
-15	19,3

Key: 1 Temperature, °C

Table 3

Температура , град.С	
-5	5,0
-10	5,0
-15	4,0

Key: 1 Temperature, °C

Table 4

Глубина проникновения, мм	28	23	18	14
Температура, град.С	-3	-7	-10	-15

Key: 1 Depth of penetration, mm

2 Temperature, °C